

DISLOCATION FORWARD OF THE ATLAS, WITH FRACTURE OF THE ODONTOID PROCESS OF THE AXIS.

BY JAMES A. KELLY, M.D.,
OF NEW YORK CITY.

THE high mortality following dislocations and fractures of the cervical vertebræ, the few cases reported in the literature, in which the lesion was only demonstrated to a certainty after death, and the fact that in those cases which survive the condition is not always recognized, leads me to report the following case of dislocation forward of the atlas with fracture of the odontoid process of the axis. The case was observed while I was house surgeon at the Boston City Hospital, on the service of Dr. Hayward W. Cushing, to whom I am indebted for the permission to report this rare and interesting case.

The condition recognized clinically was proven without a doubt by the X-ray photograph, and the case is remarkable by the fact that there were at no time any symptoms of pressure on the spinal cord, that the patient so far recovered as to be able to continue a life of activity, and at the time of the writing of this article (January, 1905), he is able to perform manual labor in spite of the deformity present.

The history in brief is as follows:

C. F., aged forty-seven years, was admitted to the Boston City Hospital, April 17, 1904. The police who brought the patient to the hospital stated that he was arrested while intoxicated, and that on entering a cell he fell, striking his head on a sharp corner, receiving a scalp wound, for the treatment of which he was brought to the hospital. On admission the physical examination showed a man who, while moderately intoxicated, was perfectly conscious. A scalp wound about two inches in length, not exposing the bone, was present over the left parietal region. The head, held rigidly, was in a position of extreme dorsal flexion,

and rotated slightly to the right, the chin being depressed upon the chest. There was moderate muscular spasm of the neck muscles. Over the posterior aspect of the upper cervical vertebræ there was marked swelling and tenderness. No crepitus could be elicited, but through the swollen tissues there could be felt apparent marked prominence of the spinous process of the axis, and there was an increase in the distance from this spinous process to the occiput. The patient complained of considerable pain localized to the seat of the swelling, which was increased on lying down. On this account he preferred the sitting position. There were no symptoms of motor or sensory paralysis. The scalp wound was irrigated and sutured. On account of the local tenderness in the post upper cervical region, and the marked deformity, a clinical diagnosis of probable dislocation forward of the atlas with fracture of the odontoid process of the axis was made, and, in the absence of any symptoms of pressure upon the spinal cord, the treatment consisted in supporting the head with a rigid, well-fitting felt collar, and placing the patient in a semirecumbent position upon a "head rest." On the day after admission an X-ray photograph was taken, which, confirming the clinical diagnosis, showed in the lateral view a well-marked dislocation forward of the atlas (Fig. 1). It was thought at the time that, on account of the absence of pressure symptoms, there was probably a fracture of the odontoid process of the axis in combination with the dislocation. The patient being comfortable, and in the absence of pressure symptoms, no efforts were made to reduce the dislocation, the support given by the felt collar being considered sufficient to make the patient comfortable, and prevent any increase in the extent of the dislocation.

April 21. Since entrance the patient has developed no symptoms of pressure upon the spinal cord. He is more comfortable when semirecumbent upon a "head rest," or when sitting up. The collar used at the time of entrance gives perfect support to the head. Examination of the back of the neck shows slight fading ecchymosis and marked diminution in the size of the swelling, rendering palpation of the spinous processes of the cervical vertebræ more easy. Considerable tenderness is present over the swelling. There is apparent marked projection of the spinous processes of the cervical vertebræ from the second downward, which is due to the forward position of the atlas and head,

to the dorsal flexion of the latter, and to the increased distance between the spinous process of the axis and the occiput. There is still moderate rigidity of the neck muscles, the head remains slightly rotated to the right, and, while normal rotation is lessened, it is possible to left and right. Flexion and extension are markedly diminished. The scalp wound is healing by primary intention.

April 25. Local tenderness is still present. There is no change in the extent of rotation, flexion, or extension. There have developed no symptoms of pressure. The sutures were removed to-day from the scalp wound, which has entirely healed. The felt collar is still giving sufficient support to the head.

April 29. The local tenderness is decreasing. There is no change in the bony contour of the cervical vertebræ. Dorsal flexion of the head is still marked. Limitation of motion remains the same as last noted.

May 3. The patient's general condition is much improved. The local condition remains unchanged, excepting that the tenderness has almost disappeared. Yesterday, the patient was allowed to be up in a chair for a short time, and to-day was up in a chair for several hours.

May 7. The patient was allowed to be up and about the ward to-day. All swelling and tenderness of the back of the neck have disappeared. The head is still held in a dorsally flexed position. Anteroposterior movements and rotation are not so restricted, but are markedly diminished. The use of the felt collar is continued.

May 12. The patient has been up and about the ward during the greater part of the day since the last note, and has not complained of any symptoms, either local or general. Examination shows the posterior aspect of the neck and occipital region to be almost a straight line, the normal curve, formed by the junction of the posterior surface of the neck and the occiput, being obliterated. The spinous processes of the cervical vertebræ from the axis to the seventh are in a normal line, that of the axis being prominent on account of its altered relation with the occiput, and the distance between it and the latter being still greater than normal. The head remains in a position of dorsal flexion, anteroposterior motion and rotation are still diminished. The use of the felt collar is continued. The patient desires to go home, and, as there have never been any symptoms of pressure on the spinal

cord, and as he agrees to remain under observation in the outpatient department, he is discharged relieved.

Condition of patient, January 18, 1905. The patient states that he has been employed since leaving the hospital. His work consists of carrying "pig iron" and other heavy objects. He complains of some slight pain in the left side of the neck after doing a hard day's work. He has never had any symptoms of motor or sensory disturbances, anaesthesia, or neuritis. No difficulty in swallowing.

Physical examination shows the head to be held in a slightly flexed position, although the range of flexion and extension is practically normal. Rotation to the left is normal, to the right is limited to 10 to 15 degrees from the median line. The deformity in the neck still exists. The spine of the axis is very prominent. Between the spine of the axis and the occiput there is a depression due to the forward displacement of the atlas, the posterior arch of the latter being felt in the depression about one-half to three-quarters of an inch anterior to its normal position. Examination of the pharynx shows the posterior wall slightly prominent in the region of the atlas.

Since leaving the hospital, the patient has not used any supporting apparatus, and, excepting for the pain occasioned by heavy work, has had no inconvenience as a result of his injury.

The X-ray photograph (Fig. 1) demonstrates the lateral view of the dislocation. It shows that the head is markedly flexed, and that this abnormal flexion takes place at the atlaxoid junction, being due to a dislocation forward of the atlas upon the axis. Comparison with the X-ray photograph (Fig. 2) of a normal head and neck shows this forward dislocation. The line of the anterior surfaces of the bodies of the cervical vertebræ is normally a straight one, from the base of the skull downward, while the X-ray photograph of the dislocation shows that this straight line is abruptly broken at the junction of the atlas with the axis. The horizontal planes through the bodies of the cervical vertebræ normally are practically parallel, whereas the X-ray photograph of the dislocation shows that the horizontal plane through the atlas (*c, d*)

forms a marked angle, with the horizontal planes through the other cervical vertebræ (*e, f, g, h*, etc.). The photograph also shows an increased distance between the point *b*, the spinous process of the axis, and the point *a*, the nearest point of the occiput, than occurs normally. It also shows that the normal angle formed by a vertical plane through the bodies of the cervical vertebræ and a horizontal plane through the skull is markedly altered. (For the purpose of distinctness and explanation, the outlines of the vertebræ and the skull have been made.)

On account of the intimate relations existing between the two upper cervical vertebræ and the medulla oblongata, and their position above the roots of the phrenic nerves, and also above those of the other nerves supplying the muscles of respiration, dislocation or fracture of the atlas and axis is extremely dangerous. While in all cases the condition is not immediately followed by fatal results, yet the secondary changes which may take place, as hæmorrhage, inflammation, and sudden displacement due to incautious movements, usually produce death. The differentiation between dislocation and fracture without the use of the X-ray is extremely difficult, as the symptoms of the two conditions are usually the same. In dislocation forward of the atlas without fracture of the odontoid process of the axis, it is to be assumed that sudden death invariably results, on account of pressure on the medulla oblongata by the odontoid process of the axis, and the posterior arch of the atlas. When death does not occur, following forward dislocation of the atlas, the odontoid process of the axis must be fractured and carried forward by the unruptured transverse ligament.

In studying the anatomical relations between the atlas and the axis, we find that the articulation is formed not only by the lateral articulations as in the other vertebræ, but also by that between the odontoid process of the axis and the anterior arch of the atlas. This process is placed vertically behind the anterior arch of the atlas, and is firmly held in place by the transverse ligament of the atlas, by the two alar ligaments which

pass from the base of the process to the occipital bone, and by the vertical extension of the transverse ligament, the suspensory ligament, and the posterior occipito-axial ligament.

In forward dislocation of the atlas, the following three conditions are possible: (1) A fracture of the odontoid process of the axis; (2) a rupture of the transverse ligament of the atlas; and (3) a slipping of the odontoid process beneath the transverse ligament. If the two latter conditions occur in combination with the forward dislocation of the atlas, the resulting pressure on the medulla oblongata caused by the intact odontoid process and the posterior arch of the atlas will cause sudden death, on account of the resulting space being insufficient to accommodate the medulla oblongata. When the odontoid process is fractured along with the dislocation forward of the atlas, it is carried forward with the anterior arch of the atlas by the transverse ligament, dangerous compression is not necessarily produced, and the condition need not prove fatal if further displacement, compression from hæmorrhage, or inflammation does not occur, and sufficient time is given for repair to take place.

This repair may occur in fracture of the odontoid process as in that of fracture of the other vertebræ, by callus formation, which may remain fibrous or later become bony. If the displacement is not reduced, callus is formed at the seat of fracture, and ultimate union will occur between the fragments in their altered position. After a time the projecting angles and excessive callus become absorbed and ossification becomes complete, so that aside from the deformity the bony parts should become as rigid as before injury.

Figs. 3, 4, 5, and 6 are photographic reproductions of anatomical preparations of the three possible conditions that may occur with dislocation forward of the atlas. I am indebted to Dr. G. G. Davis, of the University of Pennsylvania, for the facilities afforded to me in making the anatomical preparations.

Conclusions.—The diagnosis of dislocation forward of



FIG. 3.—Vertical anteroposterior section showing normal relations of medulla oblongata, atlas, and axis.

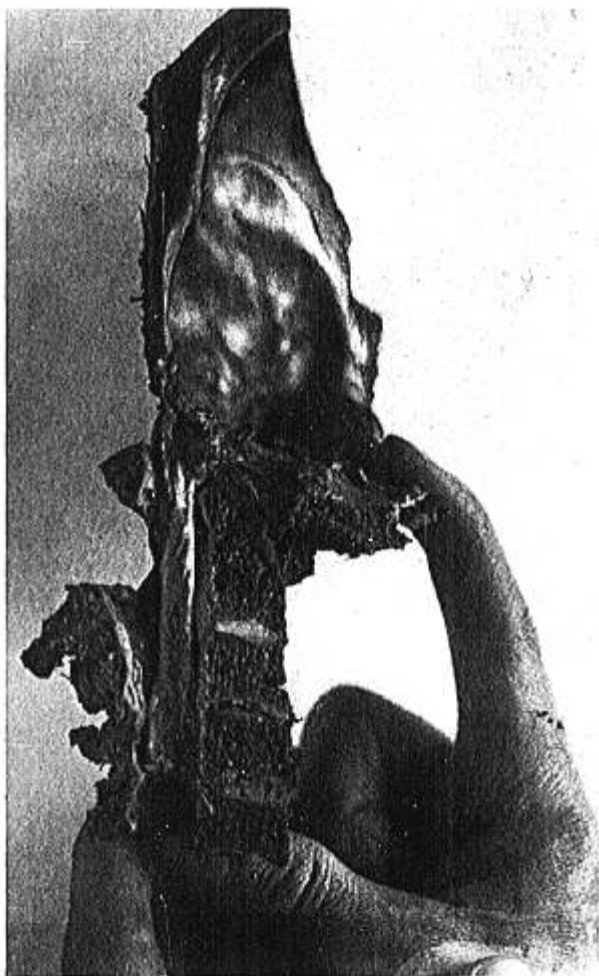


FIG. 4.—Vertical anteroposterior section showing rupture of transverse ligament and pressure on the medulla oblongata by the odontoid process of the axis and posterior arch of the atlas. Posterior atlanto-axoid ligament being ruptured.

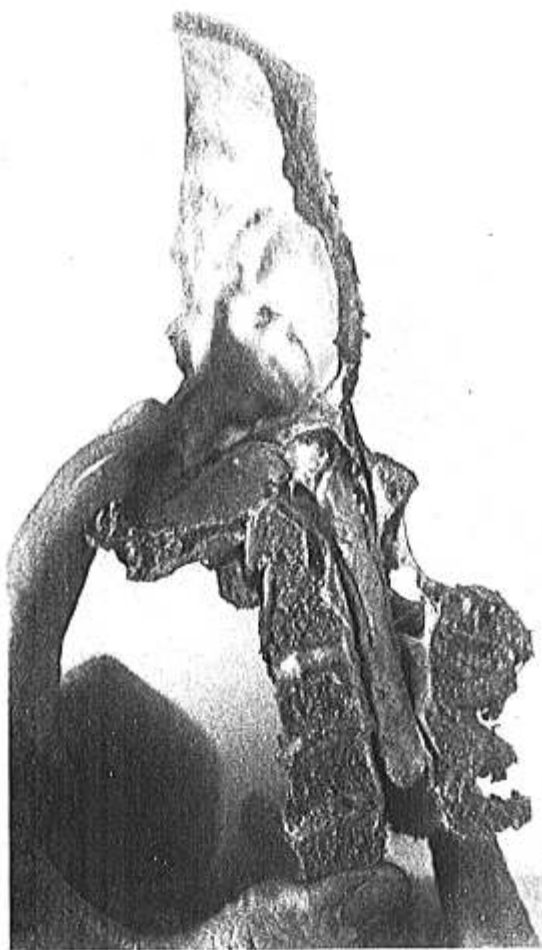


FIG. 5.—Vertical anteroposterior section showing dislocation forward of the atlas with fracture of the odontoid process, the latter being carried forward by the transverse ligament and no pressure being produced on the medulla oblongata. The posterior atlanto-axoiden ligament being ruptured.



FIG. 6.—Cross-section through atlas showing transverse ligament in front of odontoid process of axis and pressure upon the medulla oblongata by the odontoid process and posterior arch of the atlas.

the atlas upon the axis with fracture of the odontoid process of the latter, in this case, is based upon the following:

(1) The history of injury and the clinical symptoms demonstrated the condition.

(2) The X-ray photograph demonstrated the dislocation.

(3) The absence of pressure symptoms prove conclusively that a fracture of the odontoid process must have been present in combination with the dislocation.

(4) The anatomical preparations show that pressure upon the cord would have occurred unless the odontoid process had been fractured.